

BETTER TEACHING MODEL? MIDDLE SCHOOL SCIENCE CLASSROOM  
USING THE 4MAT INSTRUCTIONAL STRATEGY VS. LESSONS CREATED  
WITHOUT THIS MODEL

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The problem investigated was the need for effective and efficient learning for middle school science students to meet expectations set in *Goals 2000*. The use of the 4MAT Instructional Method was investigated as a possible method for attainment of current science standards. The study included one middle school science instructor's classes with 89 participating students. Measurements were taken and comparisons drawn using three assessment methods to determine if improved academic achievement and attitude scores resulted. Data analysis yielded no significant conclusion in either academic achievement or attitude improvement; however, observations of the researcher indicated potential usefulness of the 4MAT approach. The *t*-value calculated in the assessment methods was insufficient with a .05 probability of error present in the findings. The limitations of the study skewed the results and outweighed the possible observational insight.

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## CHAPTER ONE

### INTRODUCTION TO THE STUDY

In 1990 President George Bush, Sr., along with a committee of state governors, established eight national educational goals, referred to as *Goals 2000* (National Education Goals Panel (NEGP), 1999). These eight broad goals represented a unified front to improve educational standards from the national to the state level. The 1999 report submitted by the NEGP revealed small degrees of progress at that time. The expectations of the goals were far from being met. The United States as a whole is pursuing a more efficient and effective learning environment that stays competitive with the world. Unclear, however, are the appropriate methods to be used to facilitate this marked improvement in efficiency and effectiveness.

Is raising educational standards without a game plan for teachers going to provide the unified improvement we seek as a nation? Could this rocket some students into greater success and leave others in the proverbial dust? Levin (1992) encouraged the improvement of national standards and gave the NEGP high marks for the proposed goals, but he expressed concern about implementing *Goals 2000* without debilitating some students' performance and/or self-confidence (NEGP, 2002). Levin also stated that the 30% of the student population that is considered at risk of failing in the school environment could suffer from the new standards if they are not backed with resources and assistance to support attainment of these goals (as cited by Sanborn, 1994).

The 4MAT Instructional Strategy is the use of the learner's "natural learning cycle" in the classroom as defined by the creator of the strategy, Bernice McCarthy (1996). This

cycle starts with the experiences and knowledge a student already has and can relate to, then it adds new information or insight to be learned. Next, the learner gets a chance to manipulate or play with the new information and finally takes the learned material and applies it to the world around him/her and to his/her life. From this point in the cycle the learner builds a new base from which to relate and begin the cycle again.

The 4MAT strategy, generally considered a natural cycle of learning for all, suggests that each learner is more comfortable at one of the four main phases in the cycle. The phase where a learner feels most naturally gifted is established by analysis based on the two premises of the 4MAT strategy, which are human perception and processing of information. After this analysis, the learner's unique learning style is defined (McCarthy, & Morris, 1998). In reference to perception and processing, McCarthy states,

In new situations, some people's primary response is to sense and feel their way, while others think things through. No one uses one response to the total exclusion of the other. However, in their reactions, people hover near different places on a continuum, and that hovering place is their most comfortable place... Some people are watchers first, while others are doers... Watchers reflect on new things; they filter them through their own experiences to create meaning in a slow, deliberate choosing of perspectives. The doer acts on new information immediately.

(McCarthy & Morris, 1998, p. A.2)

The different combination of how one perceives and processes most naturally establishes which type of learner the person is. According to 4MAT (McCarthy, 1996), the Imaginative Learner perceives by feeling and processes by watching, the Analytical

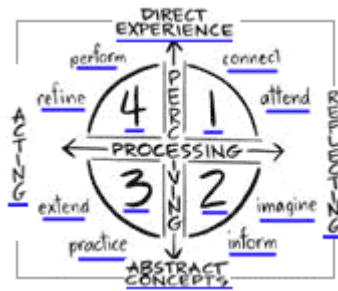
Learner perceives by thinking and processes by watching, the Common Sense Learner perceives by thinking and doing to process, and the Dynamic Learner feels the way through for perceiving and processes actively by doing.

Research by David Kolb (1973) greatly contributed to McCarthy's theories and the end product represented in the 4MAT instructional method. Kolb summarized the learning cycle by saying that the learning is part of a four-phase cycle. Immediate concrete experience is where the basis for observation and reflection occur. The observations are incorporated into a theory from which new findings for action can be construed (Kolb, Rubin, & McIntyre, 1973, p. 39). McCarthy assigned different names to Kolb's learning categories but both researchers described how individuals perceive and process. From Kolb's ideas, McCarthy developed the 4MAT approach that centers on the concept that "learning styles are approaches to learning developed by individuals over time. Differences in learning styles depend on many things: who people are, where they are, how they see themselves, what they pay attention to, and what people ask and expect of them" (McCarthy & Morris, 1998, p. A.2). In summary, individuals are biased in what they see and how they see it based on their complex patterns of individual learning styles. Experience is a common event in a person's life; knowledge is gleaned from those experiences in the various ways persons perceive and process. We all feel, reflect, think, and do, but how we linger along the way defines our learning preferences. Figure 1 depicts the labels used by McCarthy for the 4MAT design.

Figure 1.

*The 4MAT Learning Cycle* (McCarthy, 1996)





In addition to the four learning styles, the aspect of brain hemisphere preferences was taken into consideration for the development of the 4MAT instructional strategy or learning cycle. A person favors one of the hemispheres in the brain for processing, the right or the left. The learner whose operational tendency is to the right hemisphere operates, “out of being, comprehends images, seeks patterns, creates metaphors, and is simultaneous in nature” (McCarthy & Morris, 1998, p. 3.5). The learner who prefers the left-brain hemisphere operates “with analysis, uses language, abstracts experiences, has number sense, and is sequential” (McCarthy & Morris, 1998, p. 3.5). A learner does not, however, use one hemisphere in its entirety, but on the contrary, he or she switches from one hemisphere to the other dependent upon what the situation or problem calls for. As explained by McCarthy,

Human brains continually blend analysis and synthesis although different individuals tend to favor one mode over the other. How we structure tasks, set expectations, stimulate or impoverish the environment, and most of all honor these differences creates the balance or imbalance in learners. If we continue to focus on only one mode of processing we do great harm to the whole brain. (McCarthy, 1996, p. 189)

The addition of hemispheric preferences creates another aspect that was used in the development of the natural cycle of learning. Hemispheres are applied in the 4MAT strategy inside each of the four learning types. In each of these quadrants the left and right brain processes are addressed.

If each student is prone to learn and adapt to his or her environment in a distinct style of learning, as theorized by Kolb (1973), McCarthy (1996), and multiple other theorists, effective teaching would meet students' needs in those distinct ways. In theory, by aiding the instructor around this natural cycle of learning, each type of learner is addressed and feels successful in the classroom environment. This motivation, in-turn, triggers a motivation to try other areas of little practice or less comfort to the learner. The learner, again in theory, is stretched to use different ways of processing and perceiving information. As a result, a well-rounded student is produced that has developed a broader base to work from for future learning. Thus, if the method is consistently used, it should create an on-going catalyst for academic achievement and motivation.

Bloom (1976) proposed five things that improve the student's learning environment: student interest, student interest in progress, significance established to student, student knowledge that a solution will be reached, and student attentiveness to the work. If indeed Bloom's theories on classroom improvement are true and the learning cycle presented in the 4MAT Instructional Strategy improves academics and motivation, then, this might present a solution to the significant national and state goal attainment we collectively seek as a nation in the individual classroom.

### Purpose of the Study

The purpose of this study was to examine a strategy for lesson planning that could enable teachers to increase the attainment of the nation's higher standards for all students represented in the school population. The 4MAT lesson strategy provides an approach to lesson delivery that is designed to address all learners' modes of learning. The study was conducted to examine the effectiveness of 4MAT with middle school learners.

### Statement of the Problem

Middle school students often face challenges in adapting their personal perspectives for learning to the learning environment imposed in school settings. Middle school learners in science classrooms especially are challenged to adjust their processing and perceptions to the instructional strategy chosen by the teacher. The nature of the material for science classrooms is known to be more demanding than that of other disciplines. Instructional strategies are needed to ensure effective and efficient learning for middle school students in science classrooms.

### Research Questions and Related Hypotheses

1. Does the teacher's use of the 4MAT Instructional Strategy improve academic retention of science material?
2. There is a significant relationship between the use of 4MAT as an instructional strategy in the middle school classroom and student academic achievement in science.
3. Does the teacher's use of the 4MAT Instructional Strategy improve the student's motivation/attitude toward learning science material?

4. There is a significant relationship between the use of 4MAT as an instructional strategy in the middle school classroom and student motivation toward learning science material.

#### Limitations of the Study

The study was limited in that the sample chosen was small and restricted to one particular campus in a local school district. In addition, the duration of the study was very limited, in that it occurred over a ten-day period of direct instruction using the 4MAT approach in the selected teacher's classroom. The time of year when the study was conducted may have been a factor in the findings, as the study was conducted during the final month of the school year. In addition, the instructor of record for the middle school science classroom had no formal previous 4MAT training, which might have impacted her presentation using the 4MAT method with the experimental group.

#### Description of the Participants

Participants in the study were selected based solely on their membership in the selected middle school teacher's classroom. All students in the identified 6<sup>th</sup> grade science classroom were selected for inclusion in the study, thus no random selection was possible.

#### Definition of Terms

The following terms are defined to elucidate the reader's understanding of their use in the study.

*Learning Styles.* A person's learning preferences in relation to their processing and perceiving tendencies.

*Imaginative Learner.* A learner who is most comfortable watching to process and feeling through their perceptions.

*Analytical Learner.* A learner who is most comfortable watching to process new information and thinking through their perceptions..

*Common Sense Learner.* A learner who is most comfortable doing to process information and thinking through their perceptions.

*Dynamic Learner.* A learner who is most comfortable in doing to process information and in feeling through their perceptions.

*4MAT instructional strategy:* A strategy developed by Bernice McCarthy (McCarthy, Morris, 1998) that addresses four different types of learners. In addition the strategy incorporates right and left-brain hemispheric preferences. The strategy, in its most basic form, is an empty lesson plan that guides teacher around the natural cycle of learning while addressing each of the four learning types and the right and left brain hemisphere preference in each of the learning styles.

## CHAPTER TWO

### REVIEW OF THE LITERATURE

The standards that were set in *Goals 2000* were not just academic in nature (NEGP, 2002). They were and still are based on the intent to develop a society that thinks, analyzes, and produces a better standard of living for the future generation who in turn can take the torch and create an even better way for the next generation. In a country where people truly make choices an educated public is necessitated. “We teach not to produce little living libraries on the subjects; but rather to get a student to think mathematically for himself, to consider matters as a historian does; to take part in the process of knowledge-getting. Knowing is a process, not a product” (Bruner 1968, p. 72). We need to teach students that learning is a cycle that does not end, and that it is not a chore but an adventure that unlocks their hidden potentials and purpose. With the national goals in mind, there are two intertwining topics that cannot be undone in the classroom and for future decision makers in this nation; they are motivation and academics.

A study was conducted in Fresno, California during a summer school session (Full Option Science System (FOSS), 2000, p. 1-3). The school district ventured out in its language arts summer school program in an effort to develop a more effective retention strategy for at-risk students. Three elementary schools housed the summer school program and participated in this study. One of these schools had its approach to language arts changed. Staff developers worked with the school’s teachers in a literacy rich science instruction integrated with language arts. FOSS kits were used in addition to expository literature in science, narrative literature in Language Arts, shared reading, guided reading, and spelling. The district found that student attendance was higher in the

school that incorporated science and language arts, and the pre and post-tests also showed significant improvement. The other two elementary schools showed little difference in their pre and post-test scores and poor attendance in comparison with the science/language arts school. The science school that employed the hands on labs (FOSS kits) integrating science and literature motivated at-risk students to not only attend, but to achieve. Material presented to learners will lay dormant without the proper motivation to take it and make it their own. In the same way motivation without knowledge can take a learner around in circles.

In another study conducted by Sanborn (1994) three different methods were employed to find the greatest educational success in the at-risk 10<sup>th</sup> grade student population at a particular school. The methods tested were cross-age tutoring, college tutoring, and the 4MAT Instructional Strategy described in Chapter One of this report. Measurements were taken using the following categories: a state standardized test, G.P.A., the Learning and Study Strategies Inventory (LASSI), and student attendance. The at-risk students in the two tutoring method groups received one-on-one instructional help from either a college graduate or a student in a upper grade level. The 4MAT instructional group received modification as a whole class with both high- and low-risk students together. Significant improvements were noted in all but one category for the 4MAT test group in the at-risk population. The G.P.A. was increased but not as significantly as the other categories. The other two groups tested in the study lost ground with scores going down in every area for the cross-age tutoring and all but one of these categories for the college tutoring groups. The researcher found that, “Teachers who use

learning styles instructional strategies and who have both low and high risk students can expect to be able to help improve the performance of higher risk students in their class and therefore create an environment where these students are given the opportunity to learn with the same success as lower risk students” (Sanborn, 1994, p. 107).

The two above studies contain many parallels. The study specific to the 4MAT instructional method made an effort to reach the four main learning types within the natural learning cycle that 4MAT is built on. The Fresno study did not use this method but the wide range of instructional methods including hands-on activities for the Common Sense learner, shared reading for the Imaginative learner, expository science literature for the Analytical learner, and the testing and proving one-self for the Dynamic learner. While this study is not specific to McCarthy’s natural cycle of learning, all of the learners as defined by the 4MAT system were addressed and experienced success during the study. The attendance record implies that the students wanted to be there in comparison with the other two schools in the study, and the test scores showed they were learning more. Grossnickle and Thiel (1988), in their book *Promoting Effective Student Motivation in School and Classroom*, say over and over again that beyond the purposed content the teacher must consider motivational dynamics in the process of learning and teaching when planning lessons of all types. As stated earlier, academics without motivation leave learning at a low level just as motivation without knowledge can have the same disappointing results.

Motivation, indeed, plays a big role in the learning process. The other aspect in review in this chapter is the academic achievement needed to meet the nationally set



goals. The educational field is constantly pursuing the question of how to learn best, and how the brain processes information. New finds in the field of neuroscience help educators break down the importance of how material in the classroom is presented for the learner's academic growth and establishing a well-rounded individual.

The discoveries being brought forth in neuroscience are constantly being added to. One such discovery is the development of a fetus's brain. It has been found that the brain is formed by the electrical impulses in the brain changing the actual shape of the brain (Nash, 1997, p. 50-51). "At birth a baby's brain contains 100 billion neurons, roughly as many nerve cells as there are stars in the Milky Way"(p. 50). A baby's brain has all the cells it will possess in its life. Science has also found that the connections made between these cells are what develop knowledge, wisdom and understanding. Those connections, referred to as dendrites in physiological terms, are created by processing information in a new way. In essence the brain is establishing a new path; the more a path is followed, the easier it is to take. With these new discoveries, we can derive some statements in the classroom or in any learning setting; if a learner chooses to process information the same way, that path or connection becomes more established, thus increasing the ease of its use. If the learner chooses to process information in the same way he or she also chooses to avoid creating new pathways. Avoiding new connections limits our learning capabilities according to neuroscience. The implications of this information stand out for the classroom teacher and the learners. New pathways established, which have become comfortable to use, provide a feeling of success and ease for the learner. Teachers can use this success to motivate students to try new experiences

that develop more pathways thus developing the learner to greater potentials. Lowrey (1998) made a generalization over neurological science breakthroughs. “Since the brain increases dendritic growth as a result of enriching experiences, and since growth is stabilized by practice and rehearsal, the school environment can and should provide such experiences” (p. 6). Lowrey’s point is emphasized by his use of brain research conducted by Kotulak (1996, p.18) in which it was found that students who graduated from a university had 40% more connections or dendritic material than high school drop outs (p. 6). With new challenging experiences the brain is forced to form more dendritic connections and allow for a larger network of paths for the brain to use. Then, the learner is able to process and perceive information using a broader base. Susabda (1992) quoted Taylor (1967) as having said, “Enriched environments, varied experiences, and piqued interest around a central topic stimulate the production of connectors, thus allowing for more storage options in response to the experience” (p. 12). Taylor also suggested that “Very often our schools only push for academic talents, leaving other potential talents in dormancy. One approach is to provide students with opportunity to develop and increase creativity, innovation and risk-taking attributes. Broadening this band of talents functioning in schools develops more of the whole person, thereby increasing human capabilities and strengthening the total health of students of all ages” (Susabda, 1992, p. 12). This new enrichment reflects Taylor’s thought about perceiving and processing information in multiple ways. Role-play activities, labs, creative writing, note taking, reading, and webbing which force the brain to digest information differently can therefore enhance the student’s abilities.

When instructors are focused on one or a few teaching strategies in the classroom they stifle possible growth. An analogy can be made to develop this point. The lottery provides an opportunity for participants to choose six numbers out of ninety-nine; jackpots are few and far between because of the number of possible combinations that can be created by this six number string. The possible connections that can be made in this analogy pales in comparison to the connections that can be developed when dealing with 100 billion cells in one human brain that can be connected. The learning possibilities thus are endless. Thorndike (1949) showed that repetition doesn't bring forth new dendritic passages to the cells of the brain, but again establishes the pre-created pathways making these known ways more useable. Specific skills and memorized data alone found in the traditional classroom mentality provide an effective learning environment for only a small group of students, the analytical learner, whose distinct learning behavior matches up with this style of teaching but only for a short time. According to Bruner, "Knowledge that one has acquired without sufficient structure to tie it together is knowledge that is likely to be forgotten. An unconnected set of facts has a pitifully short half-life in memory" (1968, p.31). The upper-level thinking described in Bloom's taxonomy (1956) is not even pierced in this memorization of skills and data. It is a lower level of learning that reinforces fewer connectors within the brain than does a higher skill such as analysis. Analysis in opposition to straight memorization requires drawing on former information and application of that information to a particular situation. The different connections in the brain increase the person's global

understanding of not just a specific topic but its relation to other topics and opens the door to better opportunities for further upper-level thinking in the future.

The human brain is indeed a wondrous thing, unique to the individual. With the goals that have been set nationally the educational community must provide an environment that stretches learners academically to process and perceive in new ways and developing new connections, but that also create a balance with motivation. When the individuality represented in the classroom is taken into account with the knowledge that each student perceives and process information differently, a teacher could become overwhelmed. Like all big challenges a strategy is needed. This study was conducted to research the strategy found in Bernice McCarthy's 4MAT instructional method and its productiveness in academic achievement and motivation in the small sample investigated (McCarthy 1996).

## CHAPTER THREE

### METHODOLOGY

The methodology used in this study was patterned after numerous other studies that establish some consistency given the small group and time frame of measurement. A middle school science instructor participated in the study and allowed her 6<sup>th</sup> grade classes to be involved in the research of the 4MAT instructional strategy. Out of the instructor's 89 students, results from 46 of the students were used. The students who participated in the study were all enrolled in a north central Texas middle school. They all had the same science instructor. The commonality of their science instructor was the only factor taken into consideration for their selection in the study. The instructor had five classes of 6<sup>th</sup> grade science. Two of these classes were used as the control group, in which the instructor continued instruction as it had occurred normally in her class structure. The experimental group was comprised of two more classes who were taught using the 4MAT Learning Style. The remaining class was in the experimental group but was not included in the results, which will be addressed later in this chapter. The control and experimental groups comprised of the following demographic makeup were used in the analysis and findings of this research (Table 1).

Table 1

*Control Group and Experimental Group Demographics*

	M	F	ESL	LD	Caucasian	Afr. Amer.	Hispanic
Control							
Group	11	11	3	7	13	2	8
Experimental							
Group	10	14	2	4	16	3	5

(Note: ESL= English as a second language; LD= Learning disabled)

Before each of the lessons the experimenter and the instructor reviewed and modified the material and lesson plans that were created by the instructor for the control group and fitted them to the 4MAT strategy of learning for the experimental group. After developing the modifications the researcher and the instructor met one more time to review the strategy to prepare the instructor for the presentation with the experimental group.

The instructor then used the 4MAT approach to teach her 1<sup>st</sup>, 2<sup>nd</sup>, and 6<sup>th</sup> period students who represented the experimental group; she used her normal instructional strategies for 5<sup>th</sup> and 7<sup>th</sup> period students who comprised the control group. The classes experienced roughly the same workload; the instructional approach to the material was the only differing factor. The instructor selected the classes for the control and experimental groups before she received any education on the 4MAT learning style method, thus removing bias from the selection. As this study was conducted at the end of

the year, the instructor's familiarity with the classes was established. The first period class was used as the experimental trial run. It was not included in the results of this study to account for any unfamiliarity with this presentation style, and to allow for changes before the next experimental group (2<sup>nd</sup> period). This minimized possible tainting of the results and allowed for a more accurate presentation of the method, thus enhancing the results.

The instructor paired classes that she found to have the most in common. She determined this by the over-all academic level of the class and the behavioral attitudes that were present in the class. The instructor took the classes that had the most in common and put one in the experimental group and the other in the control group to achieve another level of balance. In this process an experimental and control group were each represented in the morning and afternoon classes. This pairing of courses was not planned; however, it should pull out variables that might have otherwise skewed the results. The researcher and instructor allowed this categorization to minimize variations of results due to the distinct characteristics each class had.

The study was planned over a period of 10 school days, but due to school events, field trips, etc. the study lasted 17 school days. A pre-planned unit of science material was delivered for the duration of the study. All the students began by taking a common pre-test and attitude survey. The pre-test was developed from the state mandated test, the Texas Assessment of Academic Skills (TAAS), to use an approach familiar to the students and to make sure the material being tested was correlated with state expectations. Questions were selected over the material to be covered in the unit from

released copies of the state mandated test and the Texas Essential Knowledge & Skills (TEKS) given as a six-question pre and post-test over the academic material retained. This test was comprised of six questions. Five of the questions were multiple-choice and one was an essay based on the TEKS subject material required for 6<sup>th</sup> grade science and the processing and upper-level standards expressed in the state-wide mandated curricular framework.

The attitude survey was also a state-approved test/survey developed by a grant program for physics instruction for educators in many state universities in Texas. This pre and post survey was comprised of 23 questions to probe students' attitude toward science, their science class, and learning in general. An example response item from this survey is, "Science is fun." Each of these items could be answered by five possible answers: none of the time, some of the time, half of the time, most of the time, and all of the time.

After these two indicators or tests were given, the study began with lessons taught in the instructor's normal presentation style for the control group, and in the 4MAT style for the experimental group. The researcher observed the instruction during the first period class to indicate any changes or modifications needed to fulfill the 4MAT style and to delineate more variables in the study before the instructor proceeded on to the next experimental class. After the seventeen-day period the students took the same test given before the study as a post-test and a post-attitude survey for qualitative and quantitative comparison. All the students participated in an analysis project at the end of the unit of study, which added to the qualitative results and gave the researcher a different



assessment method involving higher-level thinking. In addition the instructor gave her standard unit test that included a lab practical.

The data were collected differently for each assessment method. For the pre and post material test the researcher scored the first five multiple-choice TAAS-based questions using the correct answer for the correlating question. The last question was presented in the form of an essay to draw conclusions based on upper-level thinking used to correlate two parts of the question within the context of the subject matter presented during the course of the study. Zero to three points could be earned in this question. The researcher assigned zero points for no answer or an answer that demonstrated no knowledge of either topic. One point was given for knowledge shown on one of the topics needed in the correlation, two points were assigned for knowledge shown on both parts of the question without being able to draw a correlation between the two. Lastly, three points were given to students who demonstrated knowledge on both topics and were able to correlate them.

The researcher scored the pre and post science attitude survey based on a pre-established scoring system. The researcher read through the attitude survey and established for each question what would be the most positive answer of the five choices all the way to the most negative answer. The answer deemed the most positive was assigned a point value of 2, followed by a 1, 0 for a neutral attitude, -1, and -2 for the most negative answer. The scores could range anywhere from +46 (very positive attitude) to -46 (a very negative attitude), with a score of 0 representing a completely neutral attitude toward science. The pre and post attitude tests were scored using this

method and then the group's mean score was calculated for each. Using this data the researcher then found the gain or loss for both the experimental group and control group between the pre and post attitude survey giving the final results found later in this chapter.

The class tests were scored using answers from a pre-established key on both the written test and on the lab practical. Participants agreed to participate in the study. The instructor submitted all students' scores to be included in the final analysis for the study. Possible reasons for any participant's deletion from the results included 1) students in the 1<sup>st</sup> period class (trial run for 4MAT), 2) absences without make-up of assessment methods, and 3) students who moved in the middle of the study.

Permission for the study was obtained from the Human Subjects Committee at the University of North Texas. Both the school district and the school's principal approved the study in its entirety. Letters were given to the students to obtain consent from them and separate letters were sent home to the student's guardian(s) to inform them of the study and to obtain permission for the student's participation. The letter addressed the study and how it would be conducted, assured the anonymity students would receive, gave the estimated time the study would take, and gave the reasons the study was being conducted (Appendix A, B).

## CHAPTER FOUR

### FINDINGS OF THE STUDY

This chapter will present the results found using the testing methods in relation to the researcher's hypotheses. The testing measures used for the purpose of this study were a pre and post-material test; a pre and post-attitude survey; an instructor-created class test comprised of two parts: a lab practical and a multiple choice/fill-in-the-blank written test, both assessing the course material; and a summative project.

The results gathered on the pre and post-material test, pre and post-attitude survey, and class test were analyzed using the t-test for independent samples. The pre and post-material test and pre and post-attitude survey were computed using overall group mean gains. The class test, on the other hand, was based on raw scores because there was no prior comparative test given in which gains could be figured. The researcher analyzed the gains and scores recorded in the analysis using a probability of error of .05.

#### Quantitative Results

*Pre and Post-Test Material Gain Analysis.* The test utilized for assessing student material gain was developed using questions, covering the relevant subject material, from released copies of the TAAS test. Additionally, one essay question on the test was derived in accordance with the Texas Essential Knowledge & Skills science requirements reflecting upper-level processing in 6<sup>th</sup> graders. The method used for carrying out the assessment measure was covered in the previous chapter.

The gains for the experimental group and for the control group from the pre and post-test over the material are displayed in Table 2. No significant difference was observed using the “Distribution of  $t$ ” reference table (Gay & Airasian, 2000, pg. 615) with 30 degrees of freedom, with a probability of error set at .05, with a resulting  $t$ -value of  $-0.83$ . In order to draw a valid conclusion from the data, the  $t$ -value based on the relevant variables should have fallen within a limited range of 2.042. Since the actual  $t$ -value was significantly lower than 2.042, the difference shown between the two groups in the study was inconclusive.

Table 2

*Pre and Post-Test Material Gain in the Control and Experimental Group*

Sample Group	Mean Gain of Group	Sample Size
Control Group	1.58	22
Experimental	1.05	24

*Pre and Post-Attitude Survey Gain Analysis.* The pre and post-attitude survey was analyzed using the scoring method established in the methodology. The scores on the attitude survey ranged from -46 to 46. The gain results were computed for each group by taking the group means from the pre-test and the post-test separately and finding the gain or loss in the scores.

The results of this assessment method are represented in Table 3. The  $t$ -value was found to be  $-0.54$ . This value was insufficient to establish or disprove the researcher’s hypothesis regarding increased student attitude in the 4MAT group as opposed to the

control group. The resulting  $t$ -value in this analysis should have been closer to the pre-established  $t$ -value of 2.021 reflecting a degree of freedom set at 41.

Table 3

*Pre and Post-Attitude Survey Gain in the Control and Experimental Group*

Sample Group	Mean Gain	Sample Size
Control Group	1.40	22
Experimental	-0.32	24

*Teacher-Created Material and Practical Test Analyses.* The material and practical test was based on regular class tests the students received all year in science. Group means were calculated using raw scores from the test. The raw scores ranged from 0 to 100.

The results of the material portion of the test are represented in Table 4. The  $t$ -value was found to be -0.59. This value is notably lower than the pre-established  $t$ -value of 2.021 that reflects 44 degrees of freedom. Consequently, it is not possible to make a credible determination based on these results.

Table 4

*Material Portion of the Teacher-Created Test for the Control and Experimental Group*

Sample Group	Mean of Group	Sample Size
Control Group	78.57	22
Experimental	75.00	24

The results of the practical portion of the test are represented in Table 5. The  $t$ -value was calculated to be  $-.03$ . As observed in the results from the other tests, this resulting  $t$ -value is inadequate to support a legitimate conclusion. A more appropriate  $t$ -value should have fallen within a limited range of  $2.021$ , reflecting  $48$  degrees of freedom.

Table 5

*Practical Portion of the Teacher-Created Test for the Control and Experimental Group*

Sample Group	Mean Gain of Group	Sample Size
Control Group	3.93	22
Experimental	3.91	24

The three assessment methods discussed above did not yield significant results from which to draw valid conclusions regarding the researcher's hypotheses. The insignificance of results was determined based on comparing the researcher's data with pre-established figures in the "Distribution of  $t$ " table. Despite the inconclusive nature of the findings, this restraint does not reflect the quality of the methodology used in this study.

## CHAPTER FIVE

### THE CONCLUSIONS

The purpose of the study was to analyze a strategy, 4MAT Instructional Strategy, for lesson planning that would enable teachers to enhance the attainment of the nation's higher standards for all students represented in the school population. The 4MAT Instructional Strategy is designed to address all learners' style of learning. This study was conducted to survey the effectiveness of 4MAT with middle school learners.

#### Research Questions and Related Hypotheses

1. Does the teacher's use of the 4MAT Instructional Strategy improve academic retention of science material?
2. There is a significant relationship between the use of 4MAT as an instructional strategy in the middle school classroom and student academic achievement in science.
3. Does the teacher's use of the 4MAT Instructional Strategy improve the student's motivation/attitude toward learning science material?
4. There is a significant relationship between the use of 4MAT as an instructional strategy in the middle school classroom and student motivation toward learning science material.

The study consisted of 89 participants from which results from 46 of these students were deemed usable. Results were dismissed for one of the following reasons: (1) incomplete data on students, or (2) if the student was in the instructor's 1<sup>st</sup> period class. The first period class' results were dismissed to account for instructor

unfamiliarity with the lesson presentation method and to allow for modification to purify presentation for the following experimental classes.

The instruments used to prove or disprove the hypotheses were a pre and post-material test, a pre and post-attitude survey, and a two-part material test created by the instructor. The assessment methods were analyzed using a t-test for independent variables to compare the experimental group (4MAT Instructional Strategy used) with the control group.

### Discussion of the Results

The problem discussed in this study was the lack of a specific instructional strategy to aid middle school science students in achieving effective and efficient learning. The researcher sought to prove or disprove the 4MAT Instructional Strategy as a possible approach to counter this problem. The study resulted in the following findings.

*Hypothesis 1.* The teacher's use of the 4MAT Instructional Strategy to improve academic retention of science material was tested using the following hypothesis: there is a significant relationship between the use of 4MAT as an instructional strategy in the middle school classroom and student academic achievement in science.

The experimental group did not show greater academic achievement through the use of the pre and post-material test and the teacher-created material test. The two groups showed an insignificant degree of difference between their results. The researcher's first hypothesis, therefore, is rejected due to these findings.

*Hypothesis 2.* The teacher's use of the 4MAT Instructional Strategy to improve the student's motivation/attitude toward learning science material was tested using the



following hypothesis: a significant relationship between the use of 4MAT as an instructional strategy in the middle school classroom and student motivation toward learning science material exists.

The experimental group did not show a significant relationship between the use of the 4MAT Instructional Strategy and student motivation through the use of the pre and post-attitude survey. The control and experimental groups' results did not yield any significant difference between their results. Thus, the second hypothesis was rejected.

### Conclusions

Many limitations were identified during the study. These impacted the results, thus drawing conclusions regarding the hypotheses posed was hindered. Chapter one cited some of these limitations and more were discovered during the period of the research.

The first limitation, noted in chapter one, was the length of the study. The ten-day period of the study did not change student attitude or academic achievement according to the data. The researcher suggests that the students needed a longer period of time with the 4MAT method to overcome pre-established patterns in their science class. Furthermore, it can also be deduced that the instructor in the study, given more time to work with the 4MAT strategy, would become more fluent in its use. These two reasons support the need for a longer period of study, which would result in more conclusive data regarding the 4MAT strategy.

The second limitation was the size of the study population. A small number of student results added to the lack of significant findings in the study. The student

participants were excluded from the results if absence(s) kept the student from completing all the assessment methods used in this study. The first experimental class' results were excluded to account for the instructor's unfamiliarity with the 4MAT method. Eighty-nine students participated in the study. Seventy-three students were in the four classes where the data were used; of these students 46 student's results were actually considered in the final data analysis due to absences. The researcher submits that a larger population, even if from the same school body, would yield more informative results.

The third limitation identified was the time of year that the research was conducted. The final six weeks, in which this research occurred, contained many field trips, school assemblies, plays, and many other interruptions that detracted from the study's cohesiveness. The multiple interruptions splintered the study into fragments; In essence, this limitation enhanced the problem with the limited time of the study as mentioned in limitation one.

The ability of the 4MAT method to enable greater academic achievement and increase positive attitudes among middle school science students was not established through this study due to the numerous limitations cited. Additional study using the 4MAT Instructional Method is needed in order to draw more accurate results.

#### Recommendations for Further Study

The researcher suggests further study regarding possible correlations using the 4MAT Instructional method and improved academic achievement and increased positive attitude. It is recommended that the study last, at minimum, one six-week period. The

longer the period the more accurate the results will be. The researcher also sees a need for the study to be conducted in the beginning of the year to delineate readjustment for students and a fresh start to compare the control and experimental group. Lastly, it is recommended that future studies regarding the use of 4MAT allow for a training period for any instructors presenting using the method.

APPENDIX A  
PRE/POST MATERIAL TEST

## The Rock Cycle Pre-Test

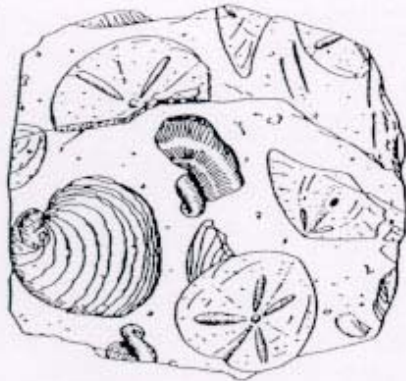
Name: \_\_\_\_\_

Period: \_\_\_\_\_

Date: \_\_\_\_\_

1. Which instrument is usually used to detect earthquake tremors?

A. Satellite  
B. Seismograph  
C. Sonar  
D. Spectroscope



2. The rock in this picture was most likely formed in a-

A. Large freshwater lake  
B. Shallow ocean bay  
C. Flowing mountain stream  
D. Deep marine trench

3. Alfred Wegner's theory of continental drift led to the theory of-

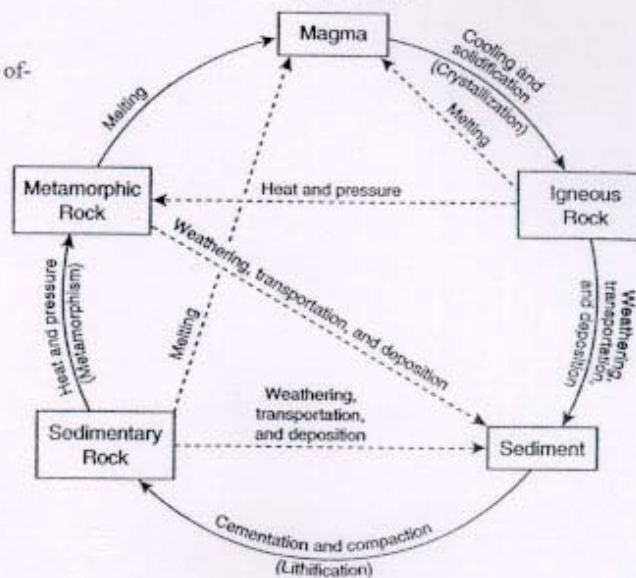
A. Gravitation  
B. Plate tectonics  
C. Uniformitarianism  
D. Carbon dating

4. According to this diagram shown at the bottom of this page, which of these statements is best supported by the information in the diagram?

A. Most of Earth's rocks are of sedimentary origin.  
B. Metamorphic rocks are formed from the cooling of magma.  
C. Igneous rocks can be formed from sedimentary rocks.  
D. Igneous rocks can be formed from sedimentary rocks.

5. According to the diagram below metamorphic rocks are formed by-

A. Weathering, transportation, and deposition  
B. Heat and pressure  
C. Melting of Rocks  
D. Cooling of Lava



### **The Rock Cycle Post-Test Continued...**

6. List one of Newton's Laws and how it relates to the rock cycle or the movement of the earth's plates.

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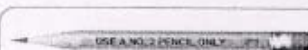
APPENDIX B  
PRE/POST ATTITUDE SURVEY

# How Do You Feel About Your Science Course?

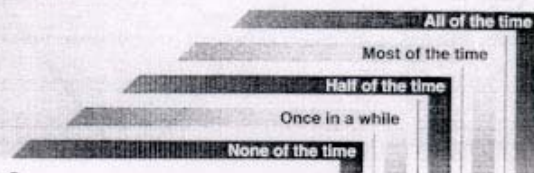
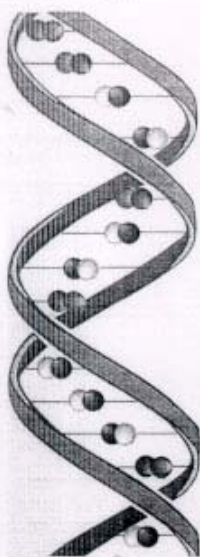
## INSTRUCTIONS:

Tell us how you feel about this science course. Read each question carefully and mark on the form provided with a pencil. Rate each question as follows:

- A = None of the time
- B = Once in a while
- C = Half of the time
- D = Most of the time
- E = All of the time



CORRECT MARK ●



A. How much do you enjoy this science course?

1. Science class is often boring.
2. Science class is usually fun.
3. I like going to science class.
4. I am afraid to ask questions.

A	B	C	D	E

B. How useful is the information taught in this course?

5. The information is useful to me.
6. The information is meaningful to my life.
7. The information should be required in science class.
8. I will be able to use the information in the future.

A	B	C	D	E

C. How did you feel in science class during this course?

9. I feel uncomfortable during this course.
10. I am curious.
11. The class makes me feel stupid.
12. I feel confident.
13. The class makes me feel successful.
14. I am unhappy in class because of this course.

A	B	C	D	E

D. What took place in the classroom during this course?

15. The teacher asks me many questions.
16. I am expected to explain ideas or events.
17. I am given plenty of time to think about answers to my teacher's questions.
18. My teacher's questions really made me think.
19. I am given enough time to answer questions.
20. The questions help me to learn about what we are studying.
21. I am given many activities to help me learn in this course.

A	B	C	D	E

E. Overall response to this course?

22. I enjoy this course.
23. I learn a lot in this course.

A	B	C	D	E

Please continue on reverse side

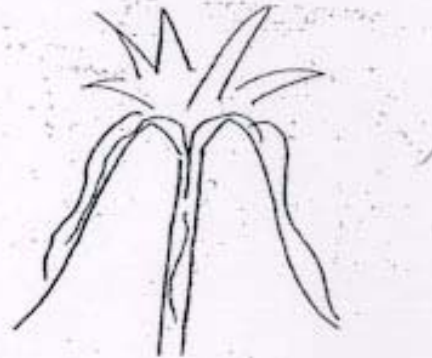


APPENDIX C  
CLASS MATERIAL TEST

Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Period: \_\_\_\_\_

## The Rock Cycle Test

1. What kind of rocks form from cooling magma?
  - a. Sedimentary Rocks
  - b. Igneous Rocks
  - c. Metamorphic Rocks
  - d. Magma Rocks
2. The word sedimentary in sedimentary rocks means ...
  - a. to cool
  - b. to be pressurized
  - c. to be changed
  - d. to settle
3. How do metamorphic rocks form?
  - a. from heat and pressure
  - b. from cooling magma
  - c. sediments settling and being under pressure
  - d. sediments under the ocean
4. What types of weathering help make sedimentary rocks?
  - a. chemical and physical
  - b. physical and energetic
  - c. physical and mechanical
  - d. mechanical and chemical
5. This picture shows the formation of what type of rock? (Sedimentary, igneous, or metamorphic)

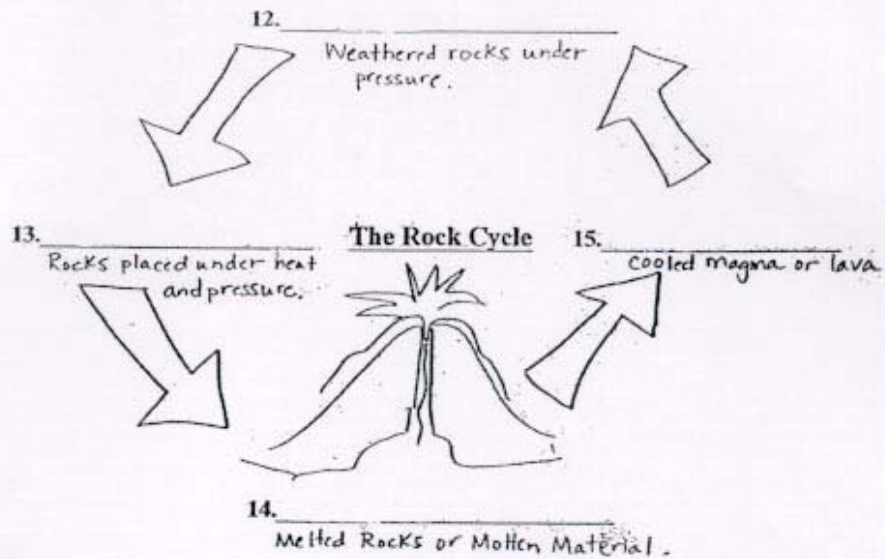


6. An igneous rock that cools below the earth's surface are called an \_\_\_\_\_ rock.

7. What causes the formation of metamorphic rocks? \_\_\_\_\_
8. One example of an igneous rock would be \_\_\_\_\_
9. Weathering causes what type of rocks? \_\_\_\_\_
10. Explain why the rock cycle is called a cycle.

11. Lava that cools is called an \_\_\_\_\_ igneous rock.

**Fill in the rock cycle below with one of the following: sedimentary rocks, igneous rocks, metamorphic rocks, or lava/magma.**



APPENDIX D  
APPROVAL LETTER FROM THE HUMAN SUBJECTS COMMITTEE

# UNIVERSITY<sup>of</sup> NORTH TEXAS

*Office of Research Services*

April 3, 2002

RE: Human Subjects Application No. 02-075

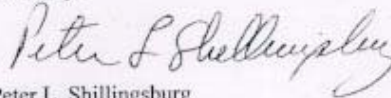
Dear Ms. DeLaney:

On March 29, 2002, the University of North Texas Institutional Review Board reviewed your project titled "Better Teaching Model? Middle School Science Classroom Using the 4MAT Learning Cycle vs. Lessons Created Without a Designed Model." The Board agrees that the risks inherent in this research are minimal, and the potential benefits to the subjects outweigh those risks. Your study is hereby approved for the use of human subjects. **Federal policy 21 CFR 56.109(e) stipulates that IRB approval is for one year only.**

Enclosed is the consent document with stamped IRB approval. Please copy and **use this form only** for your study subjects.

**U.S. Department of Health and Human Services regulations require that you submit annual and terminal progress reports to the UNT Institutional Review Board.** Further, the UNT IRB must re-review this project annually and/or prior to any modifications you make in the approved project. Please contact me if you wish to make such changes or need additional information.

Sincerely,



Peter L. Shillingsburg  
Chair  
Institutional Review Board

PS:sb

P.O. Box 305250 • Denton, Texas 76203-5250 • (940) 565-3940  
Fax (940) 565-4277 • TTY (800) RELAY TX • [www.unt.edu](http://www.unt.edu)

APPENDIX E  
LETTER OF ASSENT FOR THE STUDENTS

April 4, 2002

Dear Students,

My name is Alice Delaney and I am a Master's student at the University of North Texas. Your teacher, Ms. Rainer, and I have decided to conduct an experiment on what type of teaching works the best for students like you. You will get to participate in this experiment during your science class period from April 3<sup>rd</sup> through the rest of the month (except during TAAS week). You will either be a part of a group that is like your normal science class or a test group that does things a little differently. Everything you learn will be the same no matter which group you are in.

All of you will take a pre-test over the material that will be covered in the lessons during this experiment and an attitude survey about what you think about your science class right now. Then there will be class as normal and you will be taught in the usual way or in the experimental way, which is called the 4MAT Learning Method. Finally, all of you will take a test over the material that was covered and another attitude survey. Mrs. Rainer and I will then look over the results to see if the experimental group or the normal group made bigger improvements in their scores.

I will be writing a paper that summarizes what Ms. Rainer and I found out, but at no time will your personal information be used to identify you in my paper. No one will see your scores on the pre-test, the post-test, or attitude surveys except Ms. Rainer and myself. How you score will not be used against you or shown to anyone. This is only for our use to make us the best teachers we can possibly be.

If you do not want to participate in the study you can choose to have your scores left out from the study now or at any time during the study. This will not excuse you from your normal classroom responsibilities as a student. You will be expected to participate in the usual manner but I will not include your scores in the study.

Thank you,

APPROVED BY THE UNT IRB  
FROM 4/3/02 TO 4/2/03  
*JB*

Alice Delaney

\_\_\_\_ Yes, I will participate in this experiment and I know that my personal information will not be used to identify me.

\_\_\_\_\_  
(Student's Signature)

\_\_\_\_\_  
(Date)

This project has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (940/565-3940).

APPENDIX F  
LETTER OF CONSENT FOR THE STUDENT'S GUARDIAN(S)



April 4, 2002

Dear Guardians,

My name is Alice Delaney and I am a Master's student at the University of North Texas. While teaching a middle school science classroom of my own I made a discovery about a particular teaching method called the 4MAT Learning Style. Using this method to design my lessons, I found that my students were much more successful and enjoyed class more. The system is designed to make sure every learning style that a student could have would be addressed so that all students get a chance to receive the information in the way they process it the best. You are receiving this letter because Mrs. Rainer and I would like to discover if this phenomenon occurred because of the way I presented my lessons or if it was the program I was using.

Mrs. Rainer, your student's science teacher, is also very interested in the potential this method of teaching could bring to your student's ability to learn and process information better. We would like to team up to try this method in her science classroom. The trial period will in no way harm your student's learning as all of the same material will be presented, but the presentation style in itself will vary. We will be conducting the test April 3rd through the rest of the month (excluding the week of TAAS). Two of Mrs. Rainer's classes will be receiving the normal instruction they would get from her and three classes would be receiving the 4MAT presentation of the material. All the curriculum and state standards will be met in either presentation format.

All of Mrs. Rainer's students will take a pre-test over the material that will be covered in the lessons during this testing period and an attitude survey about what they think about their science class right now. Then the students will participate as normal in the classroom science time and will be presented information in the usual manner or in the 4MAT method. All of the students will then take a post-test over the material that was covered and another attitude survey. All of this will occur during normal class hours and your student's workload will not be increased during the study. Final, Mrs. Rainer and I will evaluate the results to see if this method increased learning in her classroom or change the atmosphere for learning.

At no time will your student's personal information be released or used to identify him/her in the study. This is solely for the researcher's future teaching benefit and Mrs. Rainer's use. At any time in the study if your student does not want to participate in the study he/she can choose to have the results excluded from the study. This, however, does not excuse students from their normal classroom responsibilities as they will be expected to participate in the usual manner but their scores will not be included in the study.

If you have any questions regarding this procedure you may contact me at anytime at 972/877-3913 or my supervising sponsor, Dr. Frances vanTassell, at 940/565-2922.

Thank you,

Alice Delaney

APPROVED BY THE UNT IRB  
FROM 4/3/02 TO 4/2/03  
RB

I agree to allow my student to participate in this study and understand that the information gathered will in no way be used to identify him/her. I also understand that the Denton I.S.D. has given permission for this study to take place.

\_\_\_\_\_  
(Parent or Guardian's Signature)

\_\_\_\_\_  
(Date)

This project has been reviewed and approved by the UNT Committee for the Protection of Human Subjects (940/565-3940).

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